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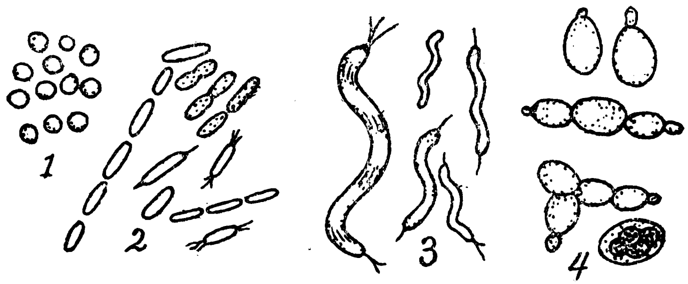
ELEMENTARY MYCOLOGY.

(Continued.)

W. A. KELLERMAN.

This second installment of a brief treatise on fungi for beginners and general readers continues the *General Outline of Plant Life* and subsequent paragraphs will deal more particularly with the systematic classification of plants, to be followed by a discussion of the groups of fungi.

HYPHÆ. — The minute structure of a fungus, or in fact that of any other plant, can not be understood without the aid of a microscope. If Bacteria are examined under a high power they will be found to consist of a body nearly transparent and having forms shown in the figures. Fig. 1 shows the circular form of Micrococcus; a Bacillus has the form indicated in Fig. 2, and a Spirillum like that of Fig. 3. Peculiar shapes and varying sizes will be shown when the Yeast-plant is examined, Fig. 4.



Figs. 1-4 Bacteria and Yeast. Fig. 1, Micrococcus; fig. 2, Bacillus; fig. 3, Spirillum; fig. 4, the Yeast plant. These and the subsequent figures are mere diagrams or outline sketches adapted from accurate figures in standard works or constructed from specimens, giving only such details as seem desirable in connection with the present purpose.

A portion of a grape leaf in which the Grape-Mildew is growing is shown in Fig. 5; the various roundish or angular cells of which the tissue of the leaf is composed and their protoplasmic granular contents are represented. There are shown also in the figure elongated or tubular cells, that ramify between the leaf-cells, and at one point they are seen to emerge from the leaf-pore or stomate; then they branch more or less profusely and finally bear roundish or oval bodies which are called the *co-nid'-i-a,* or *spores* of the fungus. All cells of which any fungus is composed, are called *hy'-phae.* A hypha may be very small, consisting of a single cell and that scarcely elongated. But in all except the simplest fungi the hyphæ are usually much elongated and they often branch, sometimes very profusely. Each hypha may be a single cell — a tubular structure (so far as the wall is concerned) with one continuous cavity. In other cases cross partitions are developed at closer or more distant points, and these septa divide the cavity into separate compartments; we then say the hypha is multi-cellular. The increase in the size of the cells in fungi and in other plants and their repeated multiplication, may result in the formation of tissue of lesser or greater extent, ultimately of simpler or more complex structure, and possibly manifold functions; also marked division of labor may ensue.

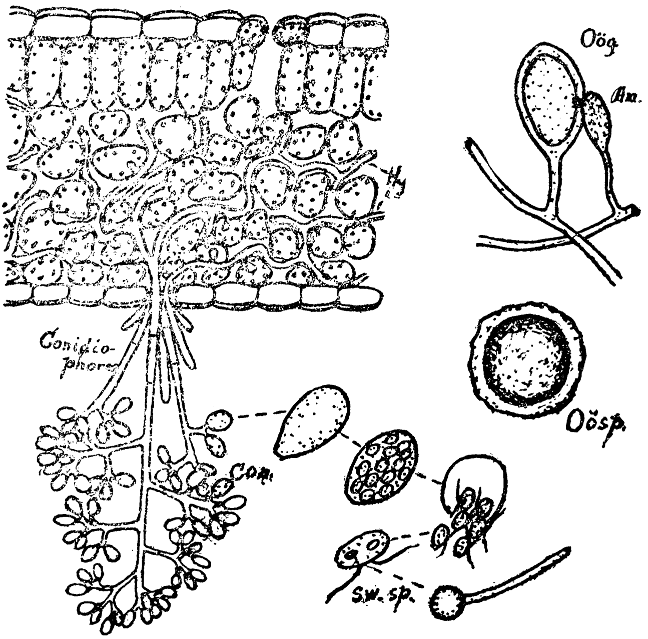


Fig. 5. Grape Mildew (Plasmopara viticola). A section of a grape leaf is shown between the cells of which the hyphae ramify and from which they draw nourishment. The hyphae emerge from a stomate in the lower surface to bear abundant conidial spores; these produce swarm-spores which grow into new plants. The two organs (*oogonium* and *antheridium*, Oög. & An.) are shown to the right above which produce the sexual spore (*Oospore*, Oösp.).

Cell Multiplication. — Unicellular organisms (plants and animals) grow only by increase in size of the single cell — a division (as in the multicellular forms) into two, these again dividing and so on, never taking place; however, it must be remembered that multiplication of individuals occurs — so-called *fission*, *i. e.*, division into two equal parts. Such unicellular individuals, while extremely numerous, comprise only a small fraction of the total number of species in the organic world. They are small forms, the great majority of them being microscopic. Reference has already been made to such examples as the microscopic Bacteria and Yeasts; correspondingly simple unicellular animals are the Amoebae, the Infusoria, and in fact all those organisms belonging to the group sometimes called the Pro-tis'-ta. But most of our well known common plants (and animals) consist of more than one cell; they are *multicellular organisms*. Yet in their earliest stage of development the plants (and animals) consisted of a single cell — for the tiny mass of protoplasm, derived from a parent mass, is the incipient cell of the individual. The biological unit, as the cell may be called, as understood to-day is not a simple homogeneous mass of matter. On the contrary, it is very complex in structure and possesses varied functions; but of these phases our knowledge is as yet very incomplete. The branch of botany that deals with the cell in its various aspects is called *Cy-tol'-o-gy*, and a large mass of literature touching this subject has already appeared. While we can not here enter even into the elements of cytology, it is well to remark that the process of division of a single cell into two cells is very complicated. In the cases best understood, the initial activity is seen in the nucleus. This is a dense, well defined, but highly complex portion of the protoplasm and ordinarily of easy recognition upon microscopic examination. Immediately after the nuclear division processes take place — for illustration of which the larger manuals of botany must be consulted — the division of the *cy'-to-plasm* follows — this term being used to designate the remaining portion of the protoplasm. Simultaneously with the division of the cytoplasm or immediately thereafter, a cell-wall, or partition wall of cellulose, is formed which completes the division of the so-called mother cell into two daughter cells. Suffice it to add that by such repeated cell divisions, the tissue of plants is built up. Naturally the cells in the early stages of development and growth are quite uniform; but this homogeneity is retained only in their *embryonic stage* — as this phase has been designated. They take on different shapes presently, and respond to the demands of a complicated organism by assuming also varied and peculiar functions.

CONTINUITY OF PROTOPLASM. — When the early plant anatomists made sections of leaf, stem and other parts, the conspicuous cavities separated and bounded by partition walls received their first attention. These they called *cells*. But the modern conception of a cell is very different. It is regarded as the living active nearly colorless *protoplasm*, and this it is which secretes or builds up the wall. The wall then is not an essential part of a living cell, though in fact being generally developed in plant organisms and forming the stable or firm, often dense and resistant, plant body. The wall consists of cellulose with which (as in all organic matter) are indissolubly united some water and mineral constituents. The chemical elements in the cellulose are Carbon, Hydrogen and Oxygen. The important elements in protoplasm are these three — Carbon, Hydrogen and Oxygen — and in addition also *Nitrogen.* The presence of the latter is very significant; all nitrogenous bodies are, potentially at least, active. The non nitrogenous on the contrary are passive. The nervous tissue, the glands, the muscles, contain nitrogen — as does also powder and dynamite; the bones and the ligaments are non-nitrogenous. Protoplasm is a highly nitrogenous substance; it does all the work involved in manufacturing food and carrying on the various processes in nutrition, growth and reproduction. In a unicellular plant, with or without a cell wall, there is but one mass of protoplasm. But those plants in which the cells divide into two, these dividing again and so on, have presently a multitude of protoplasmic masses — each cell cavity being filled with the active living substance. It is interesting to note that in a few groups of the lower plants, the nucleus divides, and this is repeated, so that finally many nuclei may be present in the cytoplasm, yet no cellulose walls are developed separating these as is the case in the higher plants. It would seem that the essential process of cell-division had taken place and that such plants (*coen'-o-cytes* they have been called) might be said to be multicellular — though not in exactly the same sense in which the term is used in reference to the higher plants. In the uni-nucleate or the multinucleate mass of protoplasm there could well be a more or less free play of the resident energy — the whole as one individual. Can such a conception be retained when the higher multicellular plants are considered? Without doubt, because it has been found that notwithstanding the existence of isolating or surrounding walls, the individual masses of protoplasm, the "cells," are in the closest sympathy; at least they maintain actual connections with each other. Minute protoplasmic threads penetrate these walls and it is this fact that is alluded to in the phrase "continuity of protoplasm." We can readily understand then that the entire plant — whether tiny herb, spreading shrub, or giant tree, — is in a real sense an indivdual, these several anatomical elements which are called cells being — not isolated like so many cemented bricks or stones in a wall, but as intimately bound together as is the case in a perfect machine; we can also with equal propriety suggest the likeness to the sympathetic organs of the human body. Work then can be co-ordinated in the highest plant — those in which the tissues are differentiated to a marked degree. Some of the tissues — composed of specially differentiated cells — do one kind of work, others perform other functions. Thus the varied processes of absorption of food materials the decomposition of carbonic dioxide and water, the formation of carbohydrates and other organic substances, digestion, assimilation and respiration are carried on, each by tissues specially differentiated for the particular work. The "division of labor," is as marked as in animals of complex structure. It is, in fact, as pronounced and as advantageous as that witnessed in the highest stages of human civilization.

TISSUE. — The differentiation of cells and tissues referred to in the previous paragraph, is illustrated in our common plants — the herbs, shrubs, and trees. There is, for example, an epidermal system of tissues — the epidermis itself consisting of a compact layer of cells with their outermost walls much thickened, usually also cuticularized, affording to the delicate tissue beneath efficient protection against the elements or other untoward exigencies; between two specially modified (so-called *guard-cells*) a pore, or *stomate,* is formed; the stomates, though extremely small. number hundreds to the square inch of leaf-surface and through these ample entrance is afforded for carbonic dioxide, as well as free passage to oxygen and watery vapor — without which the various processes in nutrition and growth could not take place. Epidermal cells may develop in the form of hairs or scales — also protecting devices. There is also a system of woody tissue — either isolated strands as in the herbaceous stems, or a coalesced mass with cells much thickened and strongly lignified as in the shrubs and trees. In all of these plants, many of them of great size, the mechanical tissues are abundantly developed — essential for support of the various parts and the maintenance of the plant-form. Equally various and complex are the tissues and cells specially concerned in nutritive and reproductive processes.

MYCELIUM. — If we pass from the common Flowering plants and Ferns to the next lower group, namely, the Mosses and Liverworts, les differentiation in the tissue is seen. There is no specially modified epidermis; there are no woody strands in the scale-like leaves — none even in the stems of the Mosses; and most Liverworts have no stems. There is, in short, less heterogeneity in the cells composing the plant. If we turn to still lower plants, the group of *Thal'-lo-phytes,* which includes the Lichens, Fungi, Algae, and Slime Moulds, less complexity in tissue will be found; instead of great heterogeneity, marked homogeneity prevails. In some of the highest representatives of this great group of plants, as the Lichens, the Toadstools, the large "sea-weeds" (marine algae), there is a comparatively large and more or less complex form of plant body. Even the interior structure is found to be somewhat intricate in these plants; but yet the cells forming the more or less compact tissue are quite similar throughout — they have not become noticeably differentiated, have not assumed varied forms, as is seen in the tissues of a Fern or a Rose. The lowest plants exhibit the greater simplicity — a single cell may constitute the entire plant though this in a few cases becomes much extended and variously branched. The many-celled Thallophytes may develop a tangled mass or thick felt of tissue; they may assume such forms as the tree-like Sea-weeds exhibit; still another direction in which the differentiation proceeds is shown in the Toadstools which have an underground part simulating a root, an erect cylindrical stem and umbrella-like cap. In all these cases the *hyphae* can readily be detected as the units or anatomical components of the plant body. To such a mass of hyphae the term *My-ce'-li-um* has been applied. The Mycelium may be sparse and loose, or it may be abundant, flocculent, felt-like, or even compacted into more or less dense tissue. The difference in manner of development as wll as structure of the compact mycelium — which is sometimes called *pseudo-paren-chy-ma* — and the true or ordinary tissue can be easily detected. In case of true tissue, such as found in all the common higher plants, a single cell divides into two, these two divide and so the process continues — the resultant cells quickly growing to the normal size — and so an extended mass of cells is formed, which are coherent and more or less firm constituting what is called true tissue; the word *par-en'-chy-ma* is sometimes applied to such a structure. The cells may now assume different shapes in different parts of the mass — in other words, differentiation to greater or less extent may take place. But in case of mycelium a single hypha only, sinple or with subsequently formed septa, may be present; but even if the hyphae are numerous and the component cells abundant and more or less compacted, they may, under the microscope, be readily unraveled and thus the origin of the false tissue (pseu'-do-par-en'-chy-ma) demonstrated.

(*To be Continued.*)

NEW GENERA OF FUNGI PUBLISHED SINCE THE YEAR 1900, WITH CITATION AND ORIGINAL DESCRIPTIONS.

COMPILED BY W. A. KELLERMAN AND P. L. RICKER.

The widely scattered, oftentimes practically inaccessible literature containing New Genera of Fungi has suggested the desirability of collecting the descriptions and reprinting them *verbatim*, with full *citations*, in one periodical for the convenience of the large and rapidly growing number of American workers. The first installment is herewith presented, covering the period 1901-1903, and will be completed in the following No. of the Journal.

At intervals of a few months *supplemental installments* will be given and will, like this, be printed also as Separates — the alternate pages being left blank.

A *card index* can be readily made, if desired, which of course would be useful to workers, and indispensable in the large scientific libraries.